

**Rb-Sr AND Sm-Nd STUDY OF ASUKA 881394: EVIDENCE OF “LATE” METAMORPHISM.** L. E. Nyquist<sup>1</sup>, C.-Y. Shih<sup>2</sup>, Y. Reese<sup>3</sup>, H. Takeda<sup>4</sup>. <sup>1</sup>KR, NASA Johnson Space Center, Houston, TX 77058. laurence.e.nyquist@nasa.gov. <sup>2</sup>ESCG Jacobs-Sverdrup, Houston, TX 77058. <sup>3</sup>Mail Code JE-23, ESCG/Muniz Engineering, Houston, TX, 77058. <sup>4</sup>Chiba Inst. of Tech., 2-17-1 Tsudanuma, Narashino City, Chiba 275-0016, Japan.

**Introduction:** The Asuka 881394 achondrite contains fossil <sup>26</sup>Al and <sup>53</sup>Mn [1,2,3] and has a <sup>207</sup>Pb/<sup>206</sup>Pb age of 4566.5±0.2 Ma [3], the oldest for an achondrite. Preliminary results showed initial <sup>146</sup>Sm/<sup>144</sup>Sm = (7.4±1.2) × 10<sup>-3</sup>, indicative of an ancient age, but <sup>87</sup>Rb-<sup>87</sup>Sr and <sup>147</sup>Sm-<sup>143</sup>Nd ages of 4370±60 and 4490±20 Ma, resp. [1], were younger than expected from the presence of short-lived nuclides. We revisit the Rb-Sr and Sm-Nd chronology of A881394 in an attempt to establish whether “late” metamorphism led to inconsistency in its apparent ages.

**Min-Pet:** The granulitic texture of A-881394 led [4] to suggest that it had experienced an extensive thermal event in which it lost Na and other volatiles, accounting for its very calcic An<sub>98</sub> plagioclase. Prior to discovery of its fossil short-lived nuclides, very calcic plagioclase and unusually magnesian pyroxene were considered to be its most important features [2,4]. It was suggested that Na may have been lost via catastrophic bombardment into a magma ocean during late-stage accretion, resulting in increased anorthite, magnesian pyroxene, and silica at the expense of albite [2].

**Rb-Sr data:** Combined data from investigations in 2001 [1] and 2010 give a “disturbed isochron” corresponding to 4.50±0.18 Ga. Evidence for early crystallization is preserved in low <sup>87</sup>Sr/<sup>86</sup>Sr of plagioclase separates. <sup>87</sup>Rb/<sup>86</sup>Sr is lower than for cumulate eucrites Y980318/433, and comparable to values for angrites. Initial <sup>87</sup>Sr/<sup>86</sup>Sr = 0.698992±19, within uncertainty of 0.698972±8 for angrite LEW86010 [5], but not clearly resolved from values for eucrites. Handpicked tridymite (2001) and a mineral separate leachate (2010) determine the isochron slope, and when combined with one pyroxene separate and its residue after leaching give an apparent secondary isochron age of 4.0±0.8 Ga.

**Sm-Nd data:** New data (2010) give an isochron age of 4.524±0.063 Ga, and all thirteen data from both investigations give 4.511±0.033 Ga. It is likely that the Sm-Nd system also has been disturbed. Handpicked tridymite (2001) plus combined leachates (2010) define an apparent age with pyroxenes of 4.4±0.2 Ga. Removing these “outliers” (tridymite and two leachates) leads to a revised age of 4.516±0.037 Ga. Combined data from both investigations give revised initial <sup>146</sup>Sm/<sup>144</sup>Sm = (9.1±1.4) × 10<sup>-3</sup> and T<sub>LEW</sub> = 4.584±0.023 Ga relative to 4558 Ma [6] and <sup>146</sup>Sm/<sup>144</sup>Sm = 7.6 × 10<sup>-3</sup> for LEW86010 [5].

**Conclusion:** Disturbed and partially reset <sup>87</sup>Rb-<sup>87</sup>Sr and <sup>147</sup>Sm-<sup>143</sup>Nd ages appear to be consistent with disturbance of these isotopic systems by some catastrophic or metamorphic events on the A881394 parent asteroid. These events followed an earlier catastrophic bombardment as envisioned by the Na-loss model leading to An<sub>98</sub> plagioclase [2]. The occurrence of such events probably continued to times <~4.4 Ga ago.

**References:** [1] Nyquist L. E. et al. 2001. *Meteoritics & Planetary Science* 36:A151. [2] Nyquist L. E. et al. 2003. *Earth & Planetary Science Letters* 214:11-25. [3] Wadhwa M. et al. 2009. *Geochim. Cosmochim. Acta*:73:5189-5201. [4] Takeda H. et al. 1997. *Antarct. Meteorite Res.* 10:401-413. [5] Nyquist L. E. et al. (1994) *Meteoritics* 29:872-885. [6] Lugmair G. W. and Galer S. J. G. 1992. *Geochim. Cosmochim. Acta* 56:1673-1694.